1. Project Title: Alternative production systems for landscape nursery production
2. Project MDAHF #: 91653
3. Principal Investigator(s): Bert Cregg. Wendy Klooster, Tom Fernandez, Pascal Nzokou
4. Reporting period: July 1, 2007- Dec. 31, 2007.
5. Accomplishments during reporting period:
We examined growth and physiological responses of seven species or cultivars of deciduous shade trees (Autumn Blaze® maple, Red sunset® maple, Bloodgood planetree, Tulip poplar, red oak, Triumph™ elm, Accolade™ elm, and hackberry) grown under four levels of fertilization. Twenty trees of each taxa were planted in 25 gallon containers in a pine bark: peat moss (80:20) mix in May 2006. The trees were placed in a Pot-in-Pot growing system at the Michigan State University Horticulture Teaching and Research Center (Fig. 1). The trees were planted as 1" - 1 ¼" bare root liners. The trees were irrigated with a micro-sprinkler system to provide approximately 1.25" of water per week. For the 2006 growing season we top-dressed each container with controlled release fertilizer (Osmocote® Plus 15-9-12) at four rates 100, 200, 300, or 400 g per container. The fertilizer rates were based on the manufacturers recommended rate for 25 gal. containers (200 to 400 g) and a low rate (1/2 lowest recommended rate). For 2007 we increased fertilization rates by 25% (i.e., 125, 250, 375, and 500 g per container) since growth of most species increased even at the highest level of fertilization in 2006 (see previous progress report). We conducted monthly assessments of physiological measurements including maximum photosynthetic rate and stomatal conductance measured with an LI-6400 portable photosynthesis system, chlorophyll fluorescence measured with a Hansatech Plant Efficiency Analyzer and chlorophyll content measure with a Minolta 505 SPAD meter. Canopy light interception of each tree was measured periodically using and 1-m long integrating quantum sensor. Foliar nutrient samples were collected from each tree in August. At the end of the 2007 growing season we collected leaves from each tree to determine total crown biomass and leaf area.

2007 Results

-Growth and foliar nutrition

As in 2006, the response of caliper growth to fertilization varied among species in 2007 (Fig. 2). In 2006, the first year after planting, growth was generally greatest at the highest level of fertilization (400 g of fertilizer per 25-gal container). Increasing fertilization rates in 2007 provided a better opportunity to observe an optimal growth response to fertilization. For all species, growth declined at 500 g per container, indicating maximum growth occurs at around 400 g per container. Foliar nutrition (as indicated by SPAD measurements) increased with increasing fertilization (Fig.3). This suggests that the highest levels of fertilizer induced luxury consumption, i.e., continued increases in foliar nutrient concentration did not result in a concomitant increase in growth. It is interesting to note that, despite the increase in foliar nutrition, maximum rates of photosynthesis did not increase consistently with fertilization (data not shown). One possible explanation for this effect is that fertilization increased tree leaf area which resulted in increased canopy transpiration and water stress. Two lines of evidence support this hypothesis. First tree canopy light interception increased with fertilization, indicating increased tree leaf area (Fig.4). Second, stomatal conductance decreased with increasing fertilization suggesting trees at the higher levels of fertilization were under relatively more water stress than trees at the lowest level of nutrition (Fig.5).

These results suggest that growth response to fertilization may be limited by water availability, even though trees were irrigated to run-off at the start of each day when gas exchange was measured.

6. Plans for next reporting period: Virtually all of the data have been collected for the project. We have submitted foliar samples for nutrient analysis and are awaiting the results. Klooster (MS student) is preparing a manuscript that will provide the final report and will be submitted for peer-reviewed publication in *HortScience.*

7.Other funding or contributions related to project:

MAES/MSUE Project GREEEN	$35,054
Michigan Nursery and Landscape Association	$3,750
Michigan Christmas Tree Association	$2,500
Michigan Forestry and Parks Association	$4,000
J. Frank Schmidt and Sons Nursery (160 1-1 ¼" bare root liners)	$7,000
Nursery Supplies Inc. (200 25-gal pot-in-pot container systems)	$3,204
Renewed Earth, Inc. (container media)	$500
MSU grounds (Equipment and labor)	$500
Scotts, Inc. (controlled release fertilizer)	$250

8.Publications/ outreach activities related to project:

CREGG, B.M. 2006. MSU Pot-in-Pot research program: A GROWING partnership. *The Michigan Landscape 49(12): 49-52.*

KLOOSTER, W.S. 2006. Improving Pot-in-Pot production for Michigan growers. MSU Extension Summer Field Research Tour. August 24, 2006, West Olive, MI

KLOOSTER, W.S., B.M. CREGG, R.T. FERNANDEZ, and P. NZOKOU. 2007. Pot-in-Pot production systems for landscape nursery trees. Research poster presented at Great Lake Trade Expo., Jan 8-10, 2007, Grand Rapids, MI.

KLOOSTER, W.S., B.M. CREGG, R.T. FERNANDEZ, and P. NZOKOU. 2007. Growth and physiology of landscape trees in response to varying nutrient levels in Pot-in-Pot production. American Society for Horticultural Science Annual Meeting, July 16-19, 2007 Scottsdale Arizona.

Klooster, W.S., B.M. Cregg, R.T. Fernandez, and P. Nzokou. 2007. Growth and physiology of landscape trees in response to varying nutrient levels for pot-in-pot production. *HortScience 42(4) 861*.

Klooster, W.S., B.M. Cregg, R.T. Fernandez, and P. Nzokou. 2007. Growth and physiology of landscape conifers in response to nutrition and container media for

Pot-in-Pot production. IN: *Proc. Southern Nursery Association Research Conference 52: 162-165.*

Figure 1. Pot-in-Pot design system used in MSU Pot-in-Pot nursery trial. Irrigation is provided by two micro-sprinklers in each container.

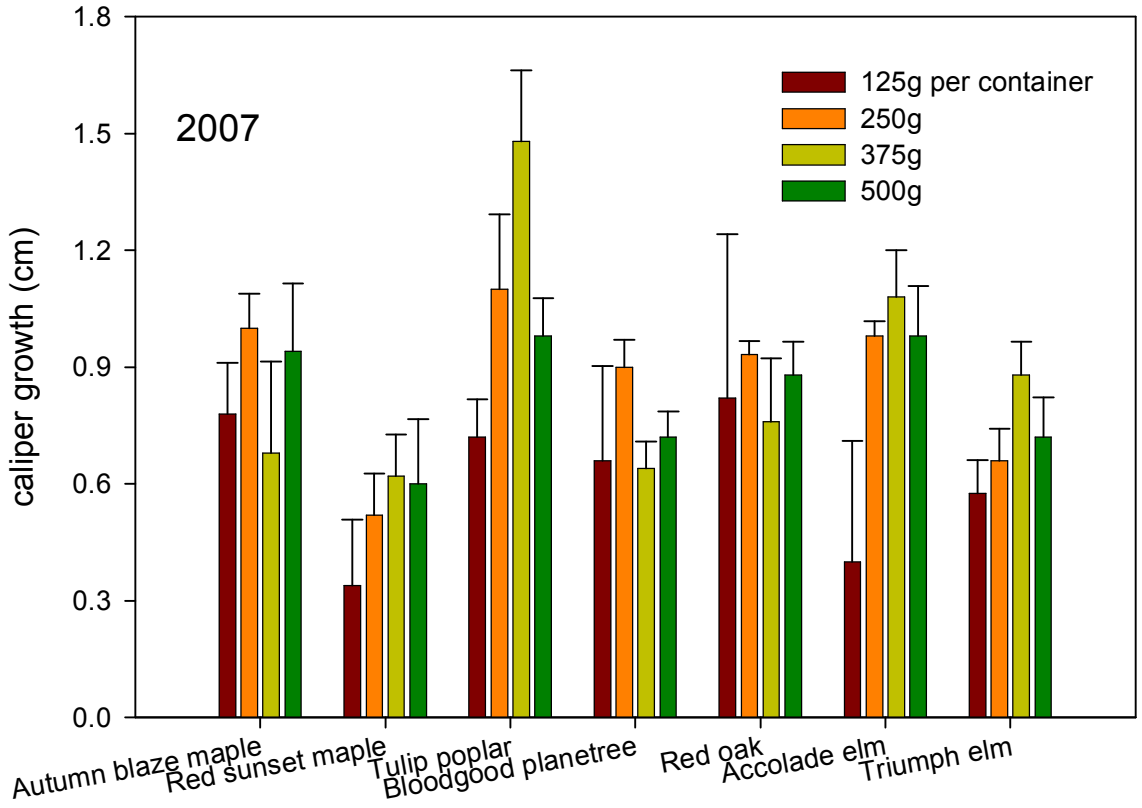

Figure 2. Caliper growth response of landscape trees to varying additions of controlled release fertilizer in the MSU Pot-in-Pot research trial, 2007. Fertilizer rates based on grams of 15-9-12 controlled release fertilizer per 25 gallon container.

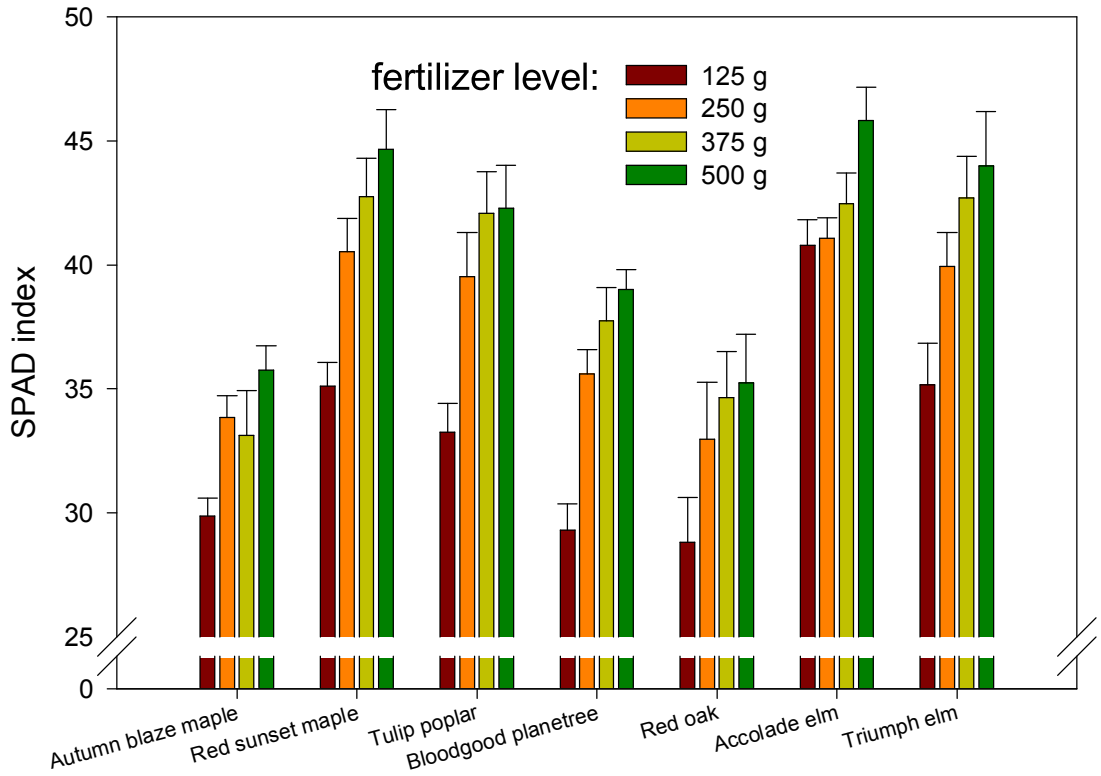

Figure 3. Mean SPAD chlorophyll index for shade trees in the MSU Pot-in-Pot fertilization trial, Summer 2007. Fertilizer rates based on grams of 15-9-12 controlled release fertilizer per 25 gallon container.

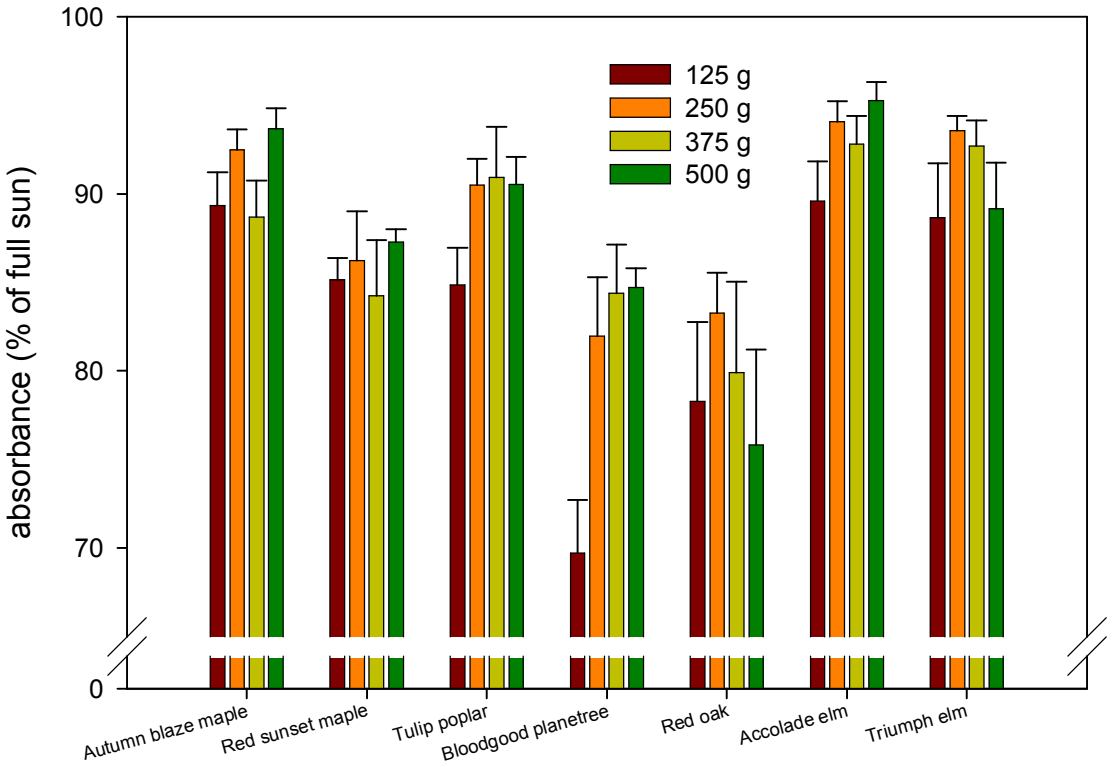

Figure 4. Mean Canopy light interception for shade trees in the MSU Pot-in-Pot fertilization trial, Summer 2007. Fertilizer rates based on grams of 15-9-12 controlled release fertilizer per 25 gallon container

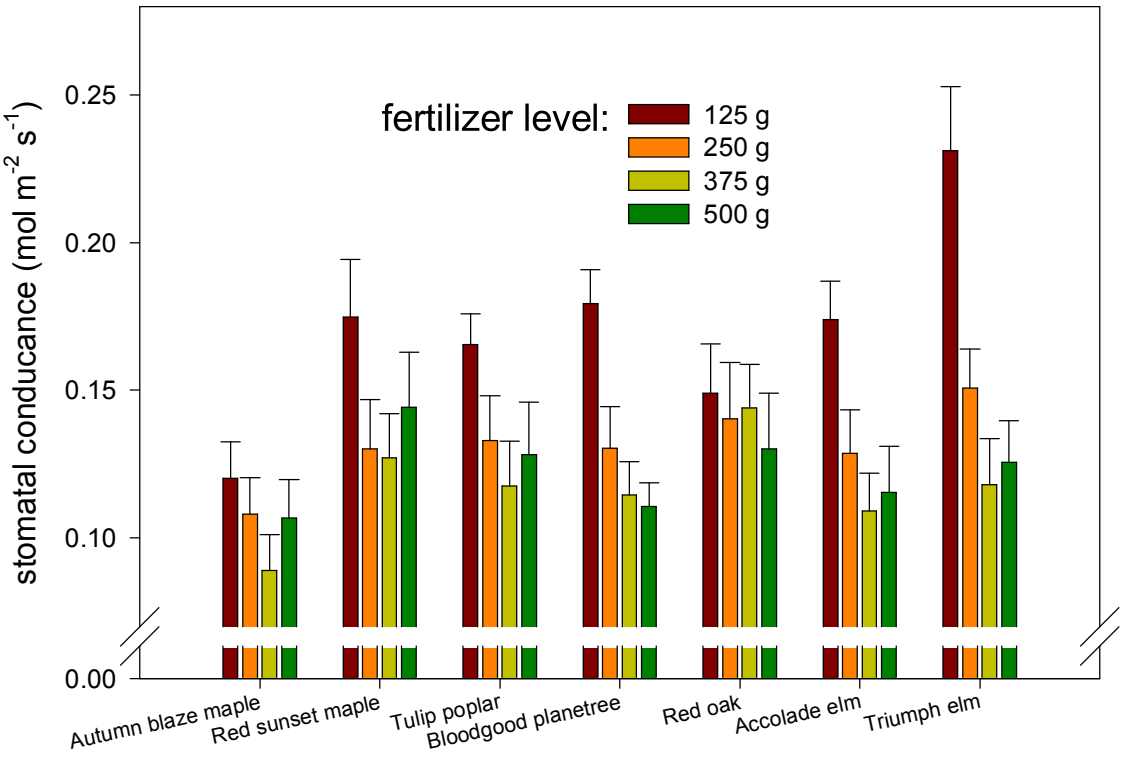

Figure 5. Mean stomatal conductance of landscape trees in the MSU Pot-in-Pot fertilization trial, Summer 2007. Fertilizer rates based on grams of 15-9-12 controlled release fertilizer per 25 gallon container.